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Title: Determination of Bag-out Material Packing Fraction

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Determination of Bag-out Material Packing Fraction

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Procedure and Calculations

- Volumetrically determined the amount of water necessary to completely fill the provided canister
- Determined the density of provided materials by directly measuring volume and mass of regularly shaped specimens using a micrometer and analytical balance, respectively
- Provided materials were packed into the canister by hand while wearing leaded glovebox gloves to mimic real procedures
- Canisters were packed as full as possible while still enabling complete closure using the canister lid
- Packed canisters were disassemble and a the weight of each component material was obtained
- Packing fraction was obtained using the calculated bulk density of each material and the packed weight of each component

$$PF = \frac{\sum(m_i/\rho_i)}{V_T} \times 100\%$$

PF = Packing Fraction (%)

m = Mass (g)

ρ = Bulk Density (g/cm³)

V_T = Total Canister Volume (cm³)

Objective:

Determine the packing fraction (vol.%) of realistically-packed canisters containing bag-out materials to inform criticality safety analysis

Packing Fraction: Bag-out Bag



- Contents:
- Partial bag-out bag (sPVC)

Contents	Mass	Volume fraction
Bag-out bag material	727.5 g	35.03%

Canister volume= 1746 *mL*
 $\rho_{sPVC} = 1.20 \pm 0.02 \text{ g/cm}^3$

Packing Fraction: Glovebox Gloves



- Contents:
- Glovebox gloves (unleaded)

Contents	Mass	Volume fraction
Glovebox gloves	767.8 g	30.59%

Canister volume= 1746 *mL*
 $\rho_{glove} = 1.44 \pm 0.03 \text{ g/cm}^3$

Packing Fraction: Cotton Wipes



- Contents:
- Cotton wipes

Contents	Mass	Volume fraction
Cotton wipes	146.9 g	45.70%

Canister volume= 1746 *mL*
 $\rho_{wipes} = 0.18 \pm 0.03 \text{ g/cm}^3$

Packing Fraction: Mixture 1



- Contents:
- 2.5 Glovebox gloves (unleaded)
 - 3 stubs (sPVC + PVC tape)

Contents	Mass	Volume fraction
Glovebox gloves	767.8 g	30.59%
sPVC	106.2 g	5.08%
PVC tape	20.1 g	0.97%
Total	894.1 g	36.64%

Canister volume= 1746 *mL*

$$\rho_{glove} = 1.44 \pm 0.03 \text{ g/cm}^3$$

$$\rho_{sPVC} = 1.20 \pm 0.02 \text{ g/cm}^3$$

$$\rho_{tape} = 1.19 \pm 0.02 \text{ g/cm}^3$$

Packing Fraction: Mixture 2



- Contents:
- Partial bag-out bag (sPVC)
 - 3 stubs (sPVC + PVC tape)

Contents	Mass	Volume fraction
sPVC	693.3 g	33.13%
PVC tape	20.1 g	0.97%
Total	713.4 g	34.10%

Canister volume= 1746 *mL*
 $\rho_{sPVC} = 1.20 \pm 0.02 \text{ g/cm}^3$
 $\rho_{tape} = 1.19 \pm 0.02 \text{ g/cm}^3$

Packing Fraction: Mixture 3



- Contents:
- Partial bag-out bag (sPVC)
 - 3 stubs (sPVC + PVC tape)
 - 3 cotton wipes

Contents	Mass	Volume fraction
sPVC	534.3 g	25.54%
PVC tape	20.1 g	0.97%
Cotton wipes	28.9 g	1.15%
Total	583.3 g	27.65%

Canister volume= 1746 *mL*

$$\rho_{sPVC} = 1.20 \pm 0.02 \text{ g/cm}^3$$
$$\rho_{tape} = 1.19 \pm 0.02 \text{ g/cm}^3$$
$$\rho_{wipe} = 0.18 \pm 0.03 \text{ g/cm}^3$$

Packing Fraction



Gloves



Cotton Wipes



Bag-out Bag



Mixture 1



Mixture 2



Mixture 3

